

THE TELEGRAPHIC JOURNAL.

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STOCK-JOBBERY IN TELEGRAPH SHARES.

It is not unworthy of comment that we commence the fortnightly publication of the TELEGRAPHIC JOURNAL on the eve of a new era in Telegraphy. The epoch is that of Amalgamation. While our land-lines may be considered to have become amalgamated under one departmental or State head, and the beneficial result is manifest, our cables appear likely to gain the same result by pursuing a similar course of action. In the East amalgamation is triumphant; in the West its progress is effected with sure and rapid strides. Amalgamation may be said to have commenced with the union under one bond of four submarine companies—the Falmouth, the Anglo-Mediterranean, the Marseilles and Algiers, and the British-Indian. Now there is to be chronicled another step, that of the union of the China, British-Australian, and British-Indian Extension Companies, leaving us only two companies—under the titles of Eastern and Eastern Extension—whereby we may communicate with India, China, and Australia. But this is not all. Scarcely a week since meetings were held at which was promulgated the amalgamation of the French Atlantic, the Anglo-American, and Newfoundland Companies. Ten companies are thus amalgamated—seven are removed and only three exist.

What are the advantages of this amalgamation? They are of the most solid character. The Public are gainers, the Shareholders are gainers; and the two essential elements of commercial enterprise—the buyer and the seller—are benefited. The public gain in what they always gain by dealing with large and important concerns, in promptness and quality of work or value; for capital can always place their requirements before the public. And the shareholders are benefited by the power of their directorate to borrow or obtain capital at lower rates of interest, while their security is increased in proportion to the extent of the amalgamation. It is a natural axiom that a single cable should be much more open to the chances of failure than would two cables, while the chances of failure of three or more are infinitely small. But not in these particulars alone are the shareholders secured. They are put out of reach of shameless machinists—of stock-jobbery, a more insidious enemy than even the *Teredo navalis*, or the broken coating of an armoured cable. “Thereby hangs a tale,” a tale we shall let some of the actors tell,

that is, the true and honourable actors in the cause. The tale was first told at the recent meeting of the *Société du Cable Transatlantique Français*. It appears that considerable jobbing has been attempted with regard to the interests of the Newfoundland Telegraph Company, and Mr. Cyrus W. Field said “that the stock-jobber had sent to him through a gentlemen now present, and offered that if he, Mr. Field, paid him £2000 sterling, and made him “square,” and gave him a thousand shares of the Newfoundland Company on the 15th April next, he would withdraw all opposition to the amalgamation.” (The stock-jobber thinks it prudent to retire from the room.) Mr. William Abbott then said, “It is only right and fair to Mr. Field, as the ambassador of the gentleman he refers to on that occasion, that I should confirm Mr. Field in every word he has stated with respect to that gentleman. I think it right to inform you that he did make the proposal, namely, that I should go to Mr. Field and ask Mr. Field to give him £2000 for expenses out of his pocket, and that on the 15th of April next, if no action were taken by the Newfoundland Government, and Mr. Field's rights in the Newfoundland Company were perfectly secured, that Mr. Field was to present him with 1000 shares of the Newfoundland Company as a free gift. I may also mention to you that he further suggested to me, in the most business-like manner, that I should share one-third of the plunder. I think Mr. Field will confirm me in stating that I took the message, as in duty bound I was, to Mr. Field, as it was told to me. I told Mr. Field the handsome offer that gentleman had made to me, and I said, ‘Mr. Field, you can do as you like; the property is in jeopardy, and the question involved is a question of millions, and if you wish it you can remove the whole difficulty for £2000, and a deferred payment, in April, 1874, when our rights are secured, for £15,000; and I said, of course, with respect to my share of the plunder I should refuse, and I would not be a party to any such piece of rascality.’ Mr. Field said, ‘Not for 15 cents; I am strong in my right, and not for 15 cents would I compound such a piece of villany.’ Gentlemen, I have been compelled to make this open statement by a clear sense of duty which I owe to my clients who invest in telegraph property, and I feel all the better that I have so discharged it.”

We can say only that the incident redounds to the integrity of two of our most important members of commercial enterprise, and also say with a venerable author, “Can such things be!”

At a recent meeting of the Geographical Society of Paris, M. Huber read an interesting paper, “On the World's Telegraphs,” in which he gave the well-known history of submarine telegraphy.

ON THE ELECTRIC FLUID.

By M. TH. DU MONCEL.

THE attention of chemists being drawn for some time to the effects produced by the induction spark, it seems to me not inopportune to give an account of the physical phenomena that I discovered in 1853, which have since been, at different periods, the occasion of interesting researches on the part of several *savants*. I believe these remarks still more called for, by the reason that some confound the effects produced by the fluid with those that result from the spark itself, and appear to ignore its particular properties. (See *Les Mondes*, vol. xxx., p. 520).

The electrical phenomena to which I have given the name of the *condensed fluid* of the induction spark is a kind of luminous discharge which is produced between two plates of glass, while these plates constitute as a whole the insulating portion of a condenser, and the armatures of this condenser are put into connection with the poles of a Ruhmkorff inductorium. Also separate the one from the other two plates of glass by a space of 2 to 3 m.m., apply externally to these plates two sheets of tin or two layers of liquid, which should be put into communication with the extremities of the induction circuit of a Ruhmkorff coil, and you obtain between the two insulating surfaces the electric fluid or flux, which will appear in the dark like a luminous rain of a blue colour, and which will disengage a certain quantity of ozone.

In order that the phenomena may be clearly apparent, it is necessary that the layer of air which separates the two plates of glass should be very dry, without which the discharge, instead of furnishing a multitude of luminous threads, concentrates itself in a small number of sparks of a violet colour, and these have not the property of the flux or fluid: we shall presently perceive the reason.

One of the most important properties of the fluid is to furnish a distributed discharge and an infinity of points on a large surface, and not to produce heat nor mechanical actions. Given this property, we can electrify a gaseous or liquid body through its entire mass without fear of complex reactions that would carry away the calorific and mechanical effects of the spark, and, as the discharge is effected between two unattackable surfaces, we can cause it to react electro-chemically, producing neither oxidation, volatilisation, nor accidental absorption, capable of perverting the products obtained. We can even, in employing as armatures layers of liquid, as M. Thenard has done, follow at will the successive effects produced.

At the time when I made known to physicists this curious property of the induction spark, of traversing glass without cracking it and without illuminating its interior, they were astonished at this kind of electrical manifestation; but to-day the numerous researches made in England upon electric condensation, as developed in submarine cables, have completely elucidated the question of electric transmission across insulating bodies, and the phenomena no longer excite surprise. It is a consequence of this that—under the influence of condensation—the molecules of the insulating body interposed are polarised in the same manner as the liquid molecules of an electrolyte: it is in this way that they contribute individually to conduct the

discharge from one surface to the other of the plates of glass. It is this phenomena to which the English have given the name of *Electrification*, and which they consider as a momentary absorption of a part of the charge, an absorption which varies with the electrostatic capacity of the insulator.

We shall not follow all the theory of these effects, which is very curious, and which I have discussed at length in my "*Exposé des Applications de l'Electricité*" (3rd edition, vol. i.), for that would take too much time; I shall speak only of the result of this method of electric transmission, and of the insulating nature of the surfaces thus electrified, that the electric charges cannot displace themselves from one point to another as on a metallic surface, and furnish, in consequence, a concentrated discharge in two or three tracks of fire, as would occur with metallic discs. But it is necessary that the layer of air interposed between the insulating surfaces should not be humid, for then—these surfaces becoming conductors—the experiment occurs under the same conditions as a discharge between metallic surfaces.

The condensed fluid of the induction spark, under certain conditions, presents the curious aspect of the stratified light that is so remarkable when the spark is passed *in vacuo*. It suffices for this to incline one or the other of the two plates of glass in such a manner as to form an acute angle. If one of the armatures is composed of a layer of water retained by a ledge of mastic, the stratifications are easily distinguished across the glass, and they disappear when the plates are again laid parallel. We also find these stratifications when the space occupied by the fluid is large and void of air. The intensity of the electric flux depends upon the relative dimensions of the armatures, and upon their polarity; it is a maximum when the smaller of the two armatures is positive. We then see around this armature a most beautiful luminous radiation; and if this armature is cut out so as to represent a *silhouette*, this appears as a dark shadow on a luminous ground.

I shall not dwell upon the physical effects which accompany the production of the flux; I have described them at length in the different editions of my notes upon Ruhmkorff's apparatus. I shall say only that from an electro-chemical point it may result from the difference of temperature of the flux and of the spark, that under certain conditions one can act inversely to the other. Also, according to M. Jean's experiments, it is shown that ozone is not abundantly produced at a low temperature, as well as that the nitric acid resulting from the combination of the elements of the air is produced only at a high temperature. In the case of the spark traversing the confined air we obtain as effect a combination; but in causing reaction upon carbonic acid, at a low temperature, with the electric flux, we decompose this acid into ozonised oxygen and oxide of carbon, as M. Jean has shown, and the result is a decomposition. At other times the effects are inverse, especially when the presence of ozone is necessary to determine a combination, as in the remarkable experiment of M. Arnould Thenard. These facts then clearly show that the method of electrification by the flux is not the same as by the spark or by galvanic action, as M. Maumené believed.

The condensed fluid or flux has been the starting-

point of important labours undertaken by Messrs. Grove, Thenard, Houzeau, Jean, and Boillot. We would here recall the curious experiments made by Mr. Grove in 1856, who produced images instantaneously upon plates of glass. In order to obtain this result, he confined between two plates of glass, submitted to electric influence, a band of paper upon which a word was written,—the word *Volta*, for example. Under the influence of the flux the portions of the surface of the glass in contact with the writing are imprinted differently to the other portions, and it is sufficient, having disengaged the printed plate, to blow upon its surface in order to produce an image of the writing, and by exposing it to the vapours of hydrofluoric acid the glass may be engraved.

In order to apply the flux to electro-chemical effects we may use two means:—we may join the two edges of the plates of glass together with mastic, and arrange two tubulures for the entrance and exit of the gas; or we may build a condenser with three tubes arranged one inside the other, so as to form an annular liquid armature.

The first system has been used by M. Jean in his researches upon ozone and carbonic acid, and by M. Ruhmkorff in his ozonometer; the second by Messrs. Thenard and Boillot. It is evident that the latter system, invented by M. Thenard, is the more perfect and practicable, much more when we employ for the armatures colourless liquids. In the apparatus of M. Boillot (see TELEGRAPHIC JOURNAL, p. 117) the armatures are of pulverised carbon.

Further details will be found in my notes on Ruhmkorff's coil (5th edition, pp. 148 to 165, pp. 334 to 336).

ON THE ELECTROMOTIVE FORCE OF VERY THIN GASEOUS LAYERS ON METALLIC PLATES.*

By F. KOHLRAUSCH.

THE so-called polarisation of electrodes through separation of gas, has hitherto been chiefly studied in its maximum form, or where the liberation of gas has been considerable; but the case in which very thin gaseous layers are formed also presents many points of interest.

I do not know whether any satisfactory explanation has been given of the electromotive force of a gas. It seems necessary of course, when any substance is found to be electromotively active, to regard it as a conductor; nor, in the present case, can aught be adduced against this. For it is highly probable, first of all, that we cannot rightly speak of a "gaseous" condition in the immediate neighbourhood of electrodes, but that the hydrogen and the oxygen exist on the platinum in a state of condensation in which their properties are different. It is known that liquid chlorine and bromine are (in the ordinary sense) "non-conductors" of electricity; but they do not give nearly such perfect insulation as is met with in the present case. A gas-layer, whose thickness was estimated at 0.00001 millimetre, gave a resistance of 1 Siem. unit, indicating a specific resistance, as compared with mercury, = 10^{10} . But we are not warranted in asserting that the gas has such low conducting

power; indeed, we know as good as nothing about the physical state of such thin layers. Thus far, therefore, I see no characteristic difference between the electromotive force of a gaseous surface and of a metallic surface.

As to experimental investigation, it is obviously impossible to preserve, any length of time, thin gaseous layers, of known quantity, in contact with a liquid; and if the quantity of gas which forms on an electrode from a continuous very weak current could be adequately measured, the question would still remain, how far the quantity diffused in the neighbourhood of the electrodes furnished electromotive force.

It seems necessary, therefore, to deal only with momentary development of gas. Edlund measured the polarisation of a voltmeter after the couple-circuit connected with it had been closed about 1-50th of a second; and found it about a fourth of the maximum possible after considerable development of gas. Becquerel experimented by comparing the polarisation in a voltmeter, produced by means of discharges from a Leyden jar, with the striking distance. The work of both observers tended to prove the (antecedently probable) law, that the electromotive force of thin gaseous layers is proportional to their thickness.

By using currents which rapidly change in direction, but in which the quantities of electricity are equal, one can make continuous observations. I adopted this method:—The currents induced by the rotation of a magnet within a multiplier passed into a tube containing dilute sulphuric acid, the electrodes being of polished platina, and about 108 □m.m. surface. As the quantity of water decomposed by each current (at each half-revolution of the magnet) was estimated at less than $\frac{1}{50,000,000}$ millimetre, we expected the polarisation-action to disappear. Instead of this, the deflection in a Weber electro-dynamometer, when there was introduced, alternately, the liquid and an equal metallic resistance, was much smaller with the former if the rotation was slow. What at first seemed very paradoxical, however, was the fact, that beyond a certain speed of rotation, the deflections with the liquid became considerably greater; or, in other words, small electrodes can, in certain circumstances, give a current of greater intensity than large ones in the same position.

The idea here first suggested that, with small electromotive forces, Ohm's law does not hold good for electrolytes, was after various experiments rejected. The fact remained that such small quantities of gas as the above mentioned exerted a considerable electromotive force.

Subsequent examination fully explained the phenomena in question, and confirmed the previous assertion of a proportionality between polarisation and quantity of gas. It is found that, in the circumstances described, the polarisation of the electrodes acts in opposition to the induction of the alternating current on itself, i.e., that the weakening extra current is diminished by the polarisation, and may in certain cases be quite neutralised.

It appears from calculation that the intensity of the current continues a simple sine function of the angle of rotation; only the maximum and nil current intensities (at passage of the magnet through the plane of

* Abstract.

the coil and its normal) being altered, and the current weakened in a definite proportion. There is a certain speed of rotation at which both current-weakening actions of polarisation and the extra current are perfectly neutralised, and then the disturbance of the function becomes nil.

This unexpected result is not without significance, as it may perhaps furnish a means of diminishing the injurious action of the extra current in magneto-electric machines. With quick rotation, the primary electromotive force of a Stöhrer or Siemens inductor will undoubtedly come nearer the sine function; and so for every velocity of rotation a determinate combination of platinum plates and sulphuric acid may be found, which, introduced into the circuit, will compensate the weakening through the extra current.

The following table gives the numerical results in the experiments above referred to, and shows a close correspondence with the result obtained from calculation:—

Number of revolutions.	Deflection of the Dynamometer in Scale Parts.		Obs.—Calc.	Deflection with equal Metallic resistance.
	Observed.	Calculated.		
5'90	0'08	0'07	—0'01	3'6
8'56	0'30	0'29	—0'01	7'6
9'61	0'50	0'46	—0'04	9'5
10'79	0'90	0'73	—0'17	12'0
13'59	2'10	1'80	—0'30	18'8
19'22	7'10	7'40	+0'30	36'8
27'19	29'90	28'70	—1'20	70'2
38'45	99'50	104'40	+4'90	129'0
54'37	304'00	300'00	—4'00	220'0
76'90	556'00	559'00	+3'00	342'0

The number 74,800 was found to express the electromotive force which would produce the unit quantity of electricity (which, with unit current, in unit time, flows through unit cross section), by developing the 108 □m.m. electrodes equivalent quantities of oxygen and hydrogen, if the proportionality between electromotive force and quantity of gas hold good to the extent of this charge. To reduce from 108 to 1 □m.m., the 74,800 must be multiplied by 108, and thus we obtain what may be called the first polarisation constant, the value 8,080,000. The meaning of this number may but be expressed thus:—

When the unit current (according to Weber's magnetic measure), has decomposed water during $\frac{1}{8,080,000} = 0'000,000,124$ second, between platinum electrodes of 1 □m.m. surface the electromotive force produced corresponds to the polarisation of 1 Siem. Weber, or (as 1 Daniell = 11'7 of this unit), the current 1 Weber produces, in $\frac{1}{690,000} = 0'000,001,45$ second, on platinum electrodes 1 □m.m., the polarisation of 1 Daniell, (or, in 1'45 seconds on electrodes of 1 square metre.)

To connect these numbers with those for the separate gaseous layers, we find, that through a current of 1 Weber, there is decomposed in one second 0'00933 milligrm. water; hence, in 0'000000124 seconds 0'0000000116 milligrm. or 0'0000000013 milligrm. hydrogen and 0'0000000103 milligrm. oxygen are separated. These quantities, therefore, coating platinum plates of 1 □m.m., give the electromotive force of 1 Siem. Weber. Otherwise: the polarisation equal to 1 Daniell is produced through layers of 0'0000000015 milligrm. hydrogen, and 0'000000012 milligrm. on the square millimetre.

The law of proportionality between electromotive force and quantity of gas is, of course, only a first approximation within the above limits of experiment; this approximation appears at least to be remarkably correct, *i. e.*, to the extent of charging the square millimetre of the electrode with about 0'000000001 milligrm. hydrogen, and 0'000000008 milligrm. oxygen, which charge corresponds to an electromotive force of 0'6 Daniell.

A second series of experiments, differing in method, gave results very closely corresponding to those which have been detailed.

MATHEMATICS

FOR

NON-MATHEMATICIANS.

By WILLIAM PAGET HIGGS, LL.D.

INTRODUCTORY.

NUMEROUS attempts have been made to interest the general reader in the science of Mathematics. Some of these attempts have succeeded, and others have failed. A careful study of the cause of failure leads to the observation of a striking similarity in the unsuccessful attempts; and this similarity consists in dealing to excess with abstract ideas. Mathematics is a tool invaluable when applied to the shaping of some end; but it is possible even upon sharpening, grinding, or adjusting a tool to waste time. Indeed, in the cutting of rough wood an edge may be too keen. So it is with mathematics, and the reader feels that he is constantly at the grindstone. He may admit that by pre-eminence mathematics is the science of abstraction, but experience has taught him that the greatest good has arisen from its application to concrete methods.

Nor would it be difficult to prove that mathematicians by an excessive devotion to the science in its purity (the proper term for its fullest abstraction) have rendered it unpopular. In its transcendental dress the student approaches mathematics with awe; and if bold enough to question receives its teachings as Professor Airy has aptly said, "rather with the doubts of imperfect faith than with the confidence of rational conviction." In his "Principles of the Differential Calculus," Mr. Woolhouse observes with only too much reason how "it is to be regretted that most of our academical treatises on this as well as other subjects abound so much with complex algebraic processes, without the slightest traces of logical reasoning to exercise and improve the intellect. We should bear in mind that the simple execution of analytical operations acquired by dint of practice and experience is a mere common species of labour, often merely mechanical, whilst a distinct apprehension of the specific object and meaning of the operations, and a contemplation of the clearness and beauty of the various arguments employed, constitute the intellectual lore that gratifies and enriches the mind, and stimulates its energies with an ardour after the investigation of truth."

But it is time we mapped out the chart intended to be followed in these pages. For our purpose we may consider mathematics under an arbitrary division into:—

The solution of problems (*a*), in which it is required to ascertain the value of unknown (from the relation which they bear to known) and constant

quantities; and (β) to the investigation of variable quantities increasing or decreasing uniformly with regard to other quantities that are constant. When dealing with α we are in the dominion of ordinary *Algebra*; the consideration of β is effected by means of the Differential and the Integral Calculus. From the symbols and signs of operation of ordinary algebra, with the simpler applications of algebra to geometry, and the necessary investigation of the elements of trigonometrical science, we may therefore pass at once to the principles of the calculus, and place the student as early as possible in a position to understand its applications. Subsequently we may proceed to a mutual study of the doctrine of Quaternions.

The scheme is bold, perhaps too bold. Unless we had profited by the labours of many living mathematicians and of many who have passed away it would have been impossible. We lay no claim to originality. On the contrary, aid has been freely taken from every source. The absence of originality is no loss to the student—he is a gainer by the weight of the authorities consulted.

Finally, I have not attempted technicality in language, except where the technical term is self-explanatory; but I have preferred a familiar style, both in language and illustration. In any instance where I may fail to express clearly my meaning, I shall be glad, through the columns of the Journal, to give fuller explanations.

DIVISION I.—THE ALGEBRA OF CONSTANT QUANTITIES.

Symbols and the Signs of Operation.

In arithmetic we have learnt to consider two kinds of numbers, *abstract* and *concrete*. 1, 2, 3, or 4, &c., is an abstract number because it denotes an abstract idea of how many times; but 1 apple, 2 apples, or 3 apples, &c., is a concrete number because it denotes so many actual substances. We cannot see or feel 2 as a number until it is embodied in the form of two apples.

In algebra, however, the division into concrete and abstract need not be a source of trouble; for we may substitute a letter ($a, b, c \dots x, y, z$) for either an abstract or concrete number. Thus a may be put to represent 1 or 1 apple, or 2 or 2 apples. If a be taken as a kind of short way of writing one apple, $2a$ will stand for two apples; but if a is taken to represent two apples, then $2a$ will stand for four apples; and so on. Similarly, if a be taken to represent the figure 1, then $2a$ will be equal to 2. If a stand for 2, then $2a$ will equal 4.

This is enough, perhaps, to enable the student to understand the definition—*Algebra is the Science of Computation by Symbols*.

The symbols generally employed are letters of the alphabet, sometimes those of the Greek alphabet. There is no reason why any system of symbols, however arbitrary, should not have been used; but universal custom has given the preference to letters, arbitrary symbols being employed when the number of things or of abstract ideas to be represented exceeds the number of letters.

It will be convenient to remark that there is in common use in algebra a sign for equality or the words *equal to*. It is $=$. If we wish to express that one and one make or equal two, we can write 1 and $1 = 2$.

That also there is a sign for addition, called *plus*, and it is $+$. So that we can state shortly 1 added to 1 = 2, or $1 + 1 = 2$. Again there are signs for subtraction, multiplication, and division, to which we must presently refer.

There is some difference between the operations of arithmetic and those of algebra. Instance may be taken in adding 2 and 3. Arithmetically $2 + 3 = 5$; but if we place a for 2 and b for 3, we can only give the result in algebra as $a + b$, unless we previously arrange that c shall equal 5. In the last case we can say $a + b = c$, one of the simplest forms of an algebraic equation. Let us quite understand this. If we have a basket of fruit containing apples (call them a), and blackberries (call them b); we cannot say apples + blackberries equal pears, we can only give the result as fruit, which is a general and not a particular term. Consequently we must be satisfied with the statement of the contents of the basket (if we wish to describe particularly) as being apples and blackberries. Similarly, in algebra, we often cannot describe a more definite result than $a + b$. What does this negative evidence teach? It shows that the sign $+$ is a sign indicating that the action of addition is to be performed—is, in fact, a sign of operation. So are all the signs in algebra; they indicate *what is to be done* when we have found the values of the symbols or letters which they connect. A complete formula, indeed, is nothing more than a symbolic direction to perform certain actions, to attain a desired result, which result may or may not be expressed.

Electro-Physiology.

CONTINUING our record of what has been done during the session in this application of electricity, we must turn our attention to the researches of Dr. Löwenburg (*Monatschrift für Ohrenheilkunde*, No. 8), on a mode of investigating the action of the electric current upon the muscles of the middle ear. Dr. Löwenburg has invented a plan of rendering visible, by means of a manometer, the contraction of the muscles of the tympanum from the use of faradic (induced) electricity. An india-rubber plug is fitted hermetically into the external meatus; through the india-rubber there passes a capillary glass tube containing some coloured liquid. Water is introduced into the meatus, and the drop of coloured liquid acts as an indicator of the pressure upon the water. The circuit is formed by a copper wire introduced into the water in the meatus, and by inserting the other electrode into the Eustachian tube, or by a moistened sponge placed on the skin. The results have not yet been fully developed, but the experiment seems likely to set at rest the vexed question of the retraction of the membrana tympani, the retraction being more probably caused by contraction of the tensor tympani than by that of the stapedius.

In the *American Journal of Obstetrics and Diseases of Women* (Nos. 1 and 2) Dr. Ullersberger gives a number of cases of the application of electricity to the diseases of children. He considers the use of electricity in the diseases of secretion and excretion, secondary paralysis, the resolution of tumours, enuresis, as a febrifuge, and of surgical electro-therapeutics generally.

In the *Edinburgh Medical Journal* Dr. Strethill Wright describes what he terms a new battery, consisting of a Smee's arrangement with the zinc and platinum immersed in a solution of bichromate of potash and sulphuric acid.

Dr. Smith, in the *Dublin Medical Journal*, describes cases of the paralysis of the portio dura and lead palsy cured by the electric current. In cases of facial paralysis he found diminution of farado-muscular contraction and increase of galvanomuscular excitability. Leclanché's constant battery meets with his approval. Dr. Lyons, also, gives a case of double facial paralysis cured by electricity.

Il Galvani, a new Italian journal devoted to electro-therapeutics, contains a history, by Dr. Ciniselli, of five cases of thoracic aneurism treated by electrolysis. Four of the cases show that when an arterial trunk rises from the sac no benefit results from the operation. The fifth operation was very successful.

Students' Column.

Retardation in Cables. By ROBERT SABINE, C.E.

THE commercial success of a busy telegraph line depends directly upon the speed of working,—that is, the speed with which messages can be sent and received through it. And this speed of working is limited by, 1st, the inductive retardation of the line, and 2nd, the inertia of the receiving apparatus.

By retardation is meant the capacity which the cable has of converting so much dynamic electricity into static electricity, that a short wave sent into one end is lessened as it goes along, until it issues at the other end a very feeble remainder. If it is a long wave, it commences by sticking to the sides of the cable as it goes on, having to satisfy the inductive capacity of the cable; and it issues very small at first, and only gradually gains strength enough to move the receiving apparatus.

It is necessary for the student to discriminate well between retardation and inertia, and not to confuse, as has frequently been done, the inertia of the receiving-instrument in the station with the retardation in the cable. Mr. Whitehouse, in 1858,

experimenting on the Atlantic cable, found that a signal took 1'42 seconds to get itself received at the further end; he used an electro-magnet and armature. Mr. Latimer Clark, at a later date, found that through 462 miles of cable a signal took 0'161 second to be appreciated by a Hughes apparatus. And lastly, Dr. Gould, the American astronomer, found that a signal through the (1865) Atlantic cable took 0'24 second to be received on a Thomson's galvanometer. Now these—

1'420,
0'161,
and 0'240 seconds,

do not represent the retardations by the cables, but rather the inertia of the receiving-instruments. They mean simply that, with the batteries which were used in the three experiments, the weakened waves, as they arrived, required these several periods of time to get strength enough to perform the mechanical effects necessary to move the indicating parts of the three instruments; and had the instruments been changed these results would have been changed too.

It is a well-established law of inductive retardation that the time required by a signal to traverse a given cable is directly proportional to its inductive capacity, to the resistance of its conductor, and to a coefficient depending upon the nature of the material and the inertia of the receiving apparatus. Now, as we have the capacities, and resistances, and times, in all these three experiments, the coefficients are easily calculated. In a cable of unit capacity and unit copper resistance, let the time which elapses between closing the battery at one end and the observation of the signal at the other be a seconds; then with any other cable whose capacity is R and copper resistance F , the time t required for the same amplitude of wave to be reached would be—

$$t = aFR.$$

Therefore, if for any given cable t , F , and R are known,—

$$a = \frac{t}{FR} \dots \text{seconds.}$$

The values of a , deduced from the foregoing experiments, together with the other data which relate to them, are given in the following table:—

Cable.	Length Knots.	Approximate Copper Resistance in Ohms. (F.)	Approximate Capacity in Microfarads. (R.)	Observed Time. Seconds. (t.)	Coefficient of Retardation, $a = \frac{t}{FR}$ seconds.	Apparatus.
Atlantic (1858)	1020	12,240	280	1'420	$414 \cdot 3 \times 10^{-9}$	Morse.
Clark's Cable	462	10,626	144	0'161	$105 \cdot 2 \times 10^{-9}$	Hughes.
Atlantic (1865)	1896	7,650	670	0'240	$46 \cdot 8 \times 10^{-9}$	Mirror.

Here all the three values of a are different, showing that the same amplitude of the waves was not reached in order to do the work in the three experiments. The values of a in fact so obtained only show the times required for the three waves to gain the necessary strength; that Hughes's electro-magnet, employed by Latimer Clark, was affected by a wave in a quarter of the time that it would have required to set Whitehouse's magnet in action; and the still more important result bearing upon submarine telegraph signalling—that the mirror

galvanometer was moved after an interval of 46'8, as compared with 414'3, required to move the electro-magnet.

Inserting these constants, therefore, in the formula given above, supposing the actual cable retardation to be comparatively very small, it would follow that—

1. The time required for a signal through a line to become recognisable by a delicate electro-magnet is—

$$t = \frac{414}{109} FR \text{ seconds.}$$

2. The time required for a signal through a line to become recognisable by a mirror galvanometer is—

$$t = \frac{46.8}{10^9} \text{ FR} \dots \text{seconds.}$$

The relation in which these times stand to each other agrees nearly with the relation of the actual speeds of signalling with the three systems. These experiments, therefore, which were made ostensibly to determine the retarding effects of the cables, leave really these retarding effects perfectly unindicated, and give us only the *inertia* of the apparatus.

As the first application of current to a cable is to charge it, it is evident that before any employable electricity can issue from the further end, the corresponding charge must be completed. We may therefore assume that the time required by a wave to charge a cable, and the retardation on the time required for a wave passing from one end to the other to reach a given amplitude, are identical. Mr. Varley is of opinion that the electric current commences flowing out of one end of a cable at the very instant that contact is made with the battery at the other end, but that it is a considerable time before it reaches an appreciable strength; that it then goes on augmenting in strength, never absolutely attaining its maximum force. This may be so; but whatever the nature of electricity may be, it is difficult to imagine the total absence of inertia to its propagation. It is more probable that the velocity of electricity is the same in all conductors, whether submarine or overhead, or in any other form, and that it is very great, but that the resistance and induction of the circuit combine to prevent the wave reaching an appreciable strength for some time after it has commenced to flow out. This is a question, however, which can never be settled experimentally, because we can only recognise the issuing wave after it has attained strength enough to perform some mechanical effect.

PAPERS FOR JUNIOR STUDENTS.

Resistance.

BEFORE we turn our attention to the study of the laws of electro-magnetism, as exemplified in telegraphic and other electrical instruments, it will be necessary to consider the principles of electrical resistance. These principles form the most definite portions of the science, and as well afford the most important results.

Whether we regard electricity as a fluid or as a force, we shall not be able to conceive of its free passage through a conductor; but there will occur to us at once the idea of the force having to do work in order to effect the desired end. That it should not meet with resistance would be in direct opposition to the teaching of the doctrine of the conservation of energy, and would imply an inexhaustible force.

Let us try an experiment to see that a conductor offers resistance to a current. We shall require a battery of four or five cells (or two powerful cells will do), and a small glass vessel filled with sulphuric acid and water. Now if we connect two short wires to the poles of the battery, and introduce the other ends of these wires into the dilute acid in the glass vessel, keeping them about $\frac{1}{2}$ an inch apart, we shall see numerous bubbles of gas

rise to the surface of the liquid, and collect on the ends of the wire. (The phenomena is known as that of *electrolysis*; it is more intimately connected with the art of electroplating, and will be fully described in our future "THEORETICAL AND PRACTICAL ESSAYS IN ELECTROPLATING.") If we now remove one of the cells of the battery we shall perceive the bubbles are given off with less vigour, showing that a decrease in the quantity of current passing in the circuit is attended by diminution of the amount of decomposition of the acid liquid. This fact established we can proceed with our primary object, to determine the effect of introducing further lengths of wire into the circuit.

Expt. 1.—Let us take a length of fine copper wire, and introduce it somewhere in the circuit (between the battery terminal and the end of one of the wires will be most convenient); the bubbles again decrease in number and the vigour of their production, or, in technical language, the electrolytic power, is lessened. It will have been better to have used a wire 1 metre * in length.

Expt. 2.—Substitute for the fine copper wire a lead wire of the same thickness, 1 metre in length. The electrolytic power will be very weak. Indeed if a decimetre (or $\frac{1}{10}$ th of a metre) only of the lead wire had been used, the current would then have been the same, and the electrolytic power the same, as with the metre of fine copper wire.

Expt. 3.—Instead of the metre of lead wire let us substitute 10 metres of the fine copper wire; the bubbles will be given off at about the same rate as with 1 metre of the lead wire.

What have we learnt?

1. That every conductor has a specific resistance, —that is, a unit length of it offers a definite resistance to the current.

2. That the resistance offered by a conductor is directly proportional to its length.

Specific Resistance.

Prof. Clerk Maxwell says—"There are three classes in which we may place different substances in relation to the passage of electricity through them. The first class contains all the metals and their alloys, some sulphurets, and other compounds containing metals, to which we must add carbon in the form of gas-coke, and selenium in the crystalline form. In all these substances conduction takes place without any decomposition or alteration of the chemical nature of the substance, either in its interior or where the current enters and leaves the body. In all of them the resistance increases as the temperature rises. The second class consists of substances which are called electrolytes, because the current is associated with a decomposition of the substance into two components which appear at the electrodes. As a rule a substance is an electrolyte only when in the liquid form, though certain colloid substances, such as glass 100° C., which are apparently solid, are electrolytes. It would appear, from the experiments of Sir B. C. Brodie, that certain gases are capable of electrolysis by a powerful electromotive force. In all substances which conduct by electrolysis the resistance diminishes as the temperature rises. The third class consists of substances the resistance of which is so great that it is only by the most refined methods that the

* In these papers the metric system will be often employed, and the student, if he be unacquainted with it, should remedy this defect in his education speedily.

passage of electricity through them can be detected. These are called Dielectrics. To this class belong a considerable number of solid bodies, many of which are electrolytes when melted, some liquids, —such as turpentine, naphtha, melted paraffin, &c.,—and all gases and vapours. Carbon in the form of diamond, and selenium in the amorphous form, belong to this class. The resistance of this class of bodies is enormous compared with that of the metals. It diminishes as the temperature rises. It is difficult, on account of the great resistance of these substances, to determine whether the feeble current which we can force through them is or is not associated with electrolysis."

In our subsequent numbers we shall follow out this admirable classification, dealing with the electric resistance of metals, briefly of electrolytes, and of dielectrics.

Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

(Adjourned Discussion on the Block System of Working Railway Traffic.)

An ordinary meeting was held on the 14th ult., C. W. Siemens, F.R.S., in the chair.

A letter from Mr. C. V. Walker, in answer to certain views contained in Major Mallock's paper, was read by the Secretary. The writer said that Major Mallock had given expression to some opinions in reference to Mr. Walker's system, which could not fail to convey false impressions. He had said that he thought that the springs of the commutators were too weak; that the machine was liable to give reverse signals through the action of lighting; and, thirdly, that the plungers were so much alike that a man in a hurry might make a mistake. The facts in each case were otherwise. In the London district there were 180 commutators and semaphores in use, and the wear and tear on them was excessive; but not a dozen springs were broken in a year, and no repair was so simple as that of a spring. In the second place, there was no instance on record of lightning reversing a signal. It would be next to impossible for lightning to make such a signal as would deceive the signalman. As to the plungers, it was enough to say that they were 5½ inches apart, that they are one above the other, that the upper one was used to put the arm up and the lower one to put it down, and that the upper one had a white knob and the lower one a black knob. It was hardly correct to call the writer's system a single wire system. Experience had shown that one wire was sufficient, but there was nothing in the construction of the apparatus to prevent two or three wires being used.

The CHAIRMAN asked those persons who had charge of the instruments which had not been already explained to come forward and describe them. He said that some instruments had been sent from abroad by an establishment with which he was connected, and they would be explained by Mr. Risch.

Mr. Risch said that the instruments were supposed to block behind the train, and not permit two trains at once between two signal boxes. The principal points of the system were given in Major Mallock's paper. There was first of all Siemens's magneto machine, which had a handle revolving an armature, giving double currents. There were two electromagnets between the poles, which worked tongues polarised in the usual manner. Each tongue has an angle movement, and geared into a gradient, working it up and down by its oscillations in the teeth round

the circumference. This gradient formed the white and the red. The instrument was constructed so that no one coming mischievously and touching a knob could give a signal. He must perform two actions together. The person sending a signal could not himself take it off. The instrument interlocked with the semaphore. The apparatus was used in Germany, and in that country the arms up meant "line clear," and the arms horizontal meant "line blocked."

Mr. SPANGOLETTI was understood to say that thanks were due to the authors of the papers for bringing a very important subject before the Society, but they had advanced one or two views with which he could not hold. Considerable experience in working railway telegraphs had shown him that there was very great difficulty indeed in bringing up theory thoroughly into practice; and, though it was desirable to aim at a uniform system of apparatus, there were so many circumstances in connection with the various traffics on different portions of a line that it was utterly impossible to make one system applicable to the whole of the services. On a line having trains varying in speed from slow goods trains to express trains at full speed, it was needful, in working the block system, to have the distances between the signals so regulated that the trains could run without impediment at the rate of the slowest train. Then there were gradients, curves, tunnels, junctions, and crossings, for which provision had to be made. He had found it impossible to assimilate the block system throughout the whole of his own line. He had made an instrument on which he had expended a great deal of time and trouble. It had been in use on the Metropolitan line ever since its opening about eleven years ago, and had never once failed in its working, and never led to an accident. He had endeavoured to assimilate the instrument as much as possible to the signals on the line. It showed simply two things,—red for danger, and white for all right. Only one signal at a time could be shown. If the batteries got weak, as they would after a fortnight or three weeks, the signal would vibrate before it settled, or after a longer time it would show a portion of the opposite colour, but too small a portion to cause any danger. Needle instruments in the same office had been demagnetised by lightning, while his instrument had remained unaffected. He claimed for this instrument that, being a three wire system, it possessed a great advantage over a one wire system. With a one wire system it necessarily followed that if they had to signal up trains and down trains on the same wire they could not keep a persistent current, for a down train might be running at the same time as an up train, and therefore some mechanical or magnetic process had to be used to keep a signal in position. There had also been cases where lightning had reversed the signal on a one wire system. He had known cases in which the signal had been reversed by earth currents.

The speaker then came forward to the table, and illustrated his system by means of a pair of specimen instruments.

Mr. RUDELL said that he had found it very desirable to adopt the simplest system of signalling, and he had therefore made use of the single lever instrument with a bell, as introduced by Mr. Clark. This was the simplest instrument which could be used. It had a handle which acted upon the bell and the needle, and by this means all requisite signals could be conveyed. Different sorts of traffic could be distinguished by the number of beats on the bell, and all was done on one instrument. This instrument was used on the London, Chatham, and Dover line. The accident which Mr. Preece spoke of as having occurred on that line in 1871 was not due to any want of efficiency on the part of this system of signalling.

Mr. MACKIE exhibited an automatic signalling in-

strument, which had been invented by Colonel Binney. In the application of this instrument, a portion of the line was insulated, but was brought into circuit by the passing of a train, and so a signal was given. Mr. Mackie considered that a great advantage would be derived if signals could be worked automatically, and he had thought Colonel Binney's system worth bringing to the notice of the meeting.

Mr. RATCLIFFE enquired whether any precaution was taken for maintaining insulation during a snow-storm or flood. There were low-lying countries where lines were covered with two or three inches of water.

Mr. MACKIE said that he was told that water or any thing of that sort falling on the line would not interfere with the working of the system.

Colonel YOLLAND said that he had been a strenuous advocate of working lines throughout the country on what was improperly called the block system, but which, strictly speaking, was the maintenance of an interval of space between two following trains travelling on the same line. That might be accomplished either mechanically, or, much better, by the electric telegraph. He did not hesitate to say that the public at large and the managers and shareholders of railways were largely indebted to the gentlemen who had given so much time, and displayed so much patience and intelligence, in the invention of telegraphic instruments such as were now exhibited in that hall. A great number, if not the whole of those instruments, might be advantageously used for producing and maintaining the interval of space. At the last meeting he heard remarks made on the "permissive" block system. He believed that nobody knew how much good the permissive system had done towards the avoidance of accidents on the London and North Western line, which was the only one upon which the system was used for any considerable time. Strictly speaking, that system was nothing more or less than one of cautioning the driver. It was advantageous if properly carried out; but in the course of a short time, as the exigencies of traffic increased on that line, the system degenerated from what was originally intended into a system of giving a caution signal of one finger, two fingers, or three fingers, and these were not always seen by the driver of the train. Gradually that system had broken down, and he had heard with great satisfaction that it was to be abolished on the London and North Western line in favour of the absolute block. But perhaps they would excuse him for saying that the absolute block system alone would be attended with frequent collisions if the interval of space was narrowed down to forty or fifty or even seventy yards. It was perfectly impossible for an engine-driver to pull up within so few yards, especially when he did not know the power of the brakes behind him. While the interval was so short, accidents would occur, and the blame would be laid on the absolute block system or on the driver. That would be unfair to both. The system in such a case would not have a fair chance, and it would not really be what was popularly known as the maintenance of an interval of space between two trains travelling on the same line. A great deal of intelligence and ingenuity had been exercised in perfecting the various instruments that had been brought forward; but he did not hesitate to say, in favour of the original contrivance, that the single needle system, worked with simple instructions and proper discipline, would accomplish nearly everything that could be accomplished with the most perfect instrument that was on the table. Three quarters of the accidents which occurred with the absolute block system were due to want of discipline or disobedience to orders. Due allowance, however, ought to be made for the men who did the work. Their disobedience to orders was sometimes produced by their great zeal in doing what they believed to be their duty, and by

their anxiety to avoid a needless stoppage of the traffic. Last week he returned from investigating an accident, which might have been attended with the most fearful consequences. It was due to a train breaking down, and a second train being improperly permitted to follow it. Some of the poles which upheld the electric wires were broken down by the first train; the wires were brought to earth; and the needle was restored to a state which led the sender to think that he was communicating with the distant station. According to the system which was in operation on the line, the needle ought to have been pinned over at the station to which the train was proceeding; and, therefore, when the sender found that, although he could move the needle he could get no reply, he imagined that the man at the other station was busily employed in attending to other duties according to the practice on the line. He thereupon ventured to send the second train on, in direct disobedience to instructions, without telling the driver that he could not communicate with the station to which the second train was going. That showed what might occur even with the best system, when it was in the hands of men who did not know the importance of getting a direct answer. There were explicit instructions that no following train should be allowed to proceed until the distant station had replied. There was another point on which he would beg to offer a few observations. It had been stated that there was an excessive cost in introducing the absolute block system on new lines. That assertion was inaccurate. Where the traffic was small, the cost was very little more than the cost of the instruments and putting down the wires. The people who attended to the ordinary traffic were quite capable with proper instructions of working the instruments and of doing the other work; and therefore the cost of the system, beyond the instruments and the wires, was virtually nothing. On those grounds he was of opinion that no new line of railway should be opened without the block system. If it was a single line, it should be worked under two conditions, both of which were adverted to in the papers. There should be something tangible to tell the driver of a train that he was authorised to go on, and that he would not run the risk of meeting a train coming in an opposite direction. If there was only one engine in steam on the line, there was no need for any such instruction, and no block system was needed. Where there was a large amount of traffic requiring to be sent on a single line, the staff and ticket system had been adopted. He believed that the London and North Western Railway was the first to introduce the practice. A ticket was given to each of the trains that was started in one direction except the last, and the last train took a staff with it. When the last train got to the end of the journey, the staff sent back the stream of trains in the reverse direction. The staff was something tangible, and gave to the driver proper security that he might go ahead. He held that even on the newest lines, where there were only three or four trains daily, the block system was still a desirable thing, because it would prevent one train overtaking another in consequence of a breakdown or some other cause. It also trained the men into a proper system of carefulness, and increased their qualifications for working safely a larger traffic when it might arise, and when the distances between the passenger stations might have to be decreased. He had adverted to the single needle instrument, but he did not mean to say that it would answer its purpose thoroughly on such lines as those in the metropolis, where the trains followed one another at intervals of only two, three, or four minutes. Mr. Preece had understated the case as regarded the old system of time intervals, for there were many parts in the north of England where they would not work their traffic if

they were to attempt to maintain a time interval of five minutes, and the interval had been lowered to three minutes. In some places of that sort, the managers had been anxious for years to have a block telegraph, but they had not got it.

Mr. CULLEY called attention to an old form of block instrument, which was used as long ago as the year 1845. He said it was a very expensive instrument, as it had five wires, and required a distinct dial for each wire. It was a block telegraph, not only between station and station, but over the whole line. The needle system of block was introduced at a very early date. He knew from personal knowledge that it was practised at Derby previously to 1846. It was even described by Sir William Coates in his book on telegraphs, which was published in the year 1842.

Mr. CHUBB said that for some years he was the manager of the North London Railway, and had the block system in use on that line. He could therefore speak with some experience on the subject. He adopted the block system as long ago as 1855. He had no hesitation in saying that no line with a variety of traffic could be managed safely without the block system, and he should recommend it most earnestly to every one. The North London Company had trains at an interval of three minutes, and their traffic seemed to be more difficult than that of the Metropolitan Railway. The mode of working was simplicity itself. He could not help being struck the other evening by the speeches of Mr. Barlow and Mr. Leeman, who both congratulated themselves on the small amount of mischief caused by accidents, and said that the wonder was that so few accidents occurred. He must say that that was not his feeling. He felt bound to acknowledge the benefit which Col. Yolland did to him on one occasion in connection with a line of railway which joined the North London. That line was about to be opened for traffic, and was visited by Col. Yolland. There was a very large traffic passing in each direction, and the Col. maintained that something ought to be done to protect the junction from passing trains, and he said that it had occurred to him for a long time that there ought to be a mode by which the points and the signals should agree and answer to one another. Col. Yolland felt so strongly on this subject that he declined to open the new line until an arrangement had been made to carry out his view. He (Mr. Chubb) therefore picked out a clever and ingenious mechanic, named Chambers, from the engineer's shop, and put him into the signal-box to contrive a scheme. In the course of seven weeks, and after one plan had been tried without success, the object was accomplished. The Colonel was very much pleased, and gave permission to open the line. He (Mr. Chubb) felt that the man who had carried out the scheme was deserving of encouragement, and he therefore patented his invention. The patent was afterwards sold to Messrs. Saxby and Farmer, and was, in substance, their present interlocking scheme, though it had been very much improved from its original form. The invention might have turned up in some other place, had it not been made under these circumstances, but it is certain that Col. Yolland's knowledge of what was wanted, and the pressure which he put upon the company, had caused the scheme to be originated many years before it would otherwise have been carried out. He could not help adding, with reference to the block system, that Mr. Tyers's scheme was better than anything which was on the table.

Mr. W. H. PREECE, in reply, said that he was sorry that Mr. Barlow, who commenced the discussion, should have thought that the paper attributed the improvements which had taken place in the working of railways entirely to the Board of Trade, and that it ignored railway officers. No one knew better than he how much railway men had thrown their energies,

and powers of thought into the application of electricity to the working of railway traffic. Again, he had especially pointed out what he believed to be a great point, which was that a broad distinction should be drawn between the block system as an abstract principle and the instruments employed in carrying out the system. Nearly all the gentlemen who had spoken had treated the block system as being a system of instruments. The railway managers themselves, in the evidence which they gave before the Committee of the House of Lords, had based all their agreements on that idea. The block system was *in toto* an abstract principle. It had been very ably defined to-night by Col. Yolland as that system by which trains were kept apart by an interval of space. Some managers had objected to the block system on single lines with a single engine. Such a line so worked was, however, worked purely on the block system, because there the trains were kept apart by a space, which was infinite. The staff and ticket system which had been referred to as being used on single lines was in reality a permissive block. It could with the greatest ease be made an absolute block by the station at which a train with a ticket arrived, telegraphing back its arrival. Managers had objected, on the ground of expense, to the block system where the traffic was very small and the trains ran at long intervals. A long interval of time, however, secured an interval of space, and practically established a block. In such cases the arrival of a train could be telegraphed back by a bell or needle, or some cheap instrument; and the expense of a block system could be kept in proportion to the amount of traffic. Nearly all the objections which had been raised to the block system were refuted in the House of Lords Committee by railway managers themselves. His opinion that the block system should be made obligatory on all railways had been supported by Col. Yolland and Mr. Chubb in the discussion, and by the newspaper press. Mr. Leeman had understood him to mean that there was no disposition on the part of railway boards to listen to the recommendations of managers. That was not his meaning. He meant to imply that the fear of expense often intimidated managers from proposing to their boards an expenditure which would not result in increased dividends, and that the expense of the block system was one of the great causes which had retarded its introduction. He agreed with the opinion that the three-wire system had great advantages over the one-wire system. The one-wire system had certainly been greatly improved since its introduction, but it could not be hoped that all its faults could be eliminated.

The CHAIRMAN, in closing the proceedings, congratulated the Society on having the subject brought before them so well, and by men so eminently qualified to deal with it. Not only had they had papers on the subject, but also a large collection of the actual instruments employed for carrying out the block principle. The broad distinction between the English instruments and the instrument used in Germany seemed to be that in the English instrument the bell or acoustic system was invariably adhered to, while in the German instrument it had been expressly excluded as being less worthy of reliance than the optical signals. The general conclusion which had been arrived at from the consideration of the subject seemed to be that the absolute block system was the most satisfactory system for the working of a railway, in whatever way or by whatever means it might be carried out. If the block system was adopted it should be perfectly absolute, and nothing should be left to the discretion of the men. A system which would allow alterations or deviations to be made by the men was no block system at all. The block system, therefore, should be complete in itself, and there should be no exceptions permitted in its exercise. He was not

prepared to say what system could be confidently depended upon when trains ran in close succession, but a mere space system appeared to him to be very imperfect.

The Society then adjourned to November.

ROYAL SOCIETY.

The Soirée.

Sir George Biddel Airy, K.C.B., at his Soirée given as President of the Royal Society for the last time before his final resignation of the office, had drawn together several objects of electrical interest. Mr. Willoughby Smith's discovery of the effect of light upon the resistance of selenium was illustrated experimentally by Mr. Latimer Clark. A piece of selenium was enclosed in a test-tube connected at each end to platinum wires, and the tube was placed in a box with a sliding cover so as to admit any desired quantity of light. The resistance was balanced on a Wheatstone bridge, and with the aid of a Thomson galvanometer; the movement of the spot of light of course would follow any variation in the resistance of the selenium. With the box closed the resistance of the selenium remained constant, but immediately the box was opened the light-index upon the scale began to move.

Another very interesting experiment was shown by Mr. Tisley, to prove the effect of magnetism upon ordinary electrolytic action. Water being decomposed in the ordinary manner, the gases were at once set free, but on connecting the electrodes of the battery with an electro-magnet the gases commenced to revolve around the magnetic poles. A small bath was placed over the magnet, the bath itself forming one electrode, and a plate in the acidulated water of the bath the other electrode. Immediately the coil was magnetised the evolved gases commenced to revolve round the centre plate at considerable speed.

The Post-office authorities contributed a duplex system of telegraphy; Mr. W. H. Preece sent some instruments illustrating his block system of signalling and his duplex relay of 1855; Dr. Gladstone had one of the new air-batteries; and Messrs. Elliott exhibited a Thomson-Varley sliding-resistance coil. Mr. Browning's collection of philosophical instruments attracted their usual full share of notice.

Electrical Science in Foreign Journals.

(We intend to devote this column to a list of Electrical Memoirs published in Foreign Journals during the month. Those of importance will be either translated in full or given in abstract.)

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, Vol. lxxvi., No. 13.

On the Theory of the Normal Magnet, and on the Means of Augmenting Indefinitely the Force of Magnets.

—By M. J. Jamin.—At the meeting of the 16th December, 1872, I made known to the Academy the method which enabled me to measure the force necessary to draw into contact a small piece of iron placed at different points of a magnet. This force is measured in grammes; I designate it by F . Along a line drawn through the centre of this plate, parallel to its length,—that is, along its axis, the force F is *nil*, not only at the centre, but to a short distance of the two ends: it increases rapidly towards the extremities, where it forms two equal curves, the equation to which is given by Biot. The ordinates of the curve are greater towards the end than at the middle. I have studied the axial curve only; it is that to which I shall exclusively devote my attention. For homogeneous steel magnetised to saturation, F increases with the

thickness of the plate, following a probably complicate law that I have not yet studied; it does not vary sensibly with the width. All my experiments have been made with steel springs having an equal thickness of 1 m.m. The laws I am about to give apply probably to other thicknesses, with different values for the coefficients.

I. When we superpose two magnetised parallel plates the curves which represent the values of F are altered, because the magnetism quits the faces, and is to be found in the exterior portions. At the same time the curves approach one another at the centre of the magnet. This effect is augmented with a third and with a fourth plate. Finally, the two curves join at the centre. At this moment the bundle has arrived at its maximum. Any addition beyond the limit of the number of plates is entirely lost. The final magnet is that alone susceptible of precise definition; I shall call it the *normal magnet*, or the *limiting magnet*. We shall see that all magnetical questions reduce themselves to an unhopd-for simplicity.

II. The curve which represents the force F in the normal magnet is then a parabola represented by the equation $F = Ax^2$, x being the distance to the centre of the plate, and A a coefficient which varies with the length. The following numbers justify this law. We may remark that the values of F increase very rapidly with the number of layers, and arrive quickly at their maximum.

Values of the Force F .*

$2l = 480$.

Distance to the centre.	3 plates.	5 plates.	9 plates.	15 plates.	Calculated.
m.m.	grms.	grms.	grms.	grms.	grms.
240	41.0	42.0	48.2	54.3	57.6
220	25.4	36.0	40.2	45.0	48.4
190	13.9	25.6	32.6	37.2	36.1
140	9.5	17.0	16.5	20.1	19.6
90	"	7.8	8.5	8.6	8.1
40	"	1.2	1.6	1.5	1.6

III. It is difficult to determine after what number of plates the maximum is attained; but it is evident that this number increases with the length of the bundle. It will be about 3 or 4 for 100 m.m., 6 to 8 for 200, 9 to 14 for 300 m.m. We say approximately that the number is proportional to the length of the bundle.

IV. The tables show that the force of attraction at the extremity of a normal bundle increases with the length $2l$. It is 49 grms. for 480 mm., 38 for 310, 25 for 200, and 12 for 100. If we divide the forces by l we find—

Length $2l$	480	400	310	250	200	100
F	54.0	44.1	37.8	31.5	25.0	12.5
$\frac{F}{l} = k^2$	0.225	0.220	0.244	0.252	0.250	0.250

The first two quotients are too low, for the reason that the number of plates were not sufficiently numerous to obtain the exact limit of F . All the others are equal. We may conclude that the force of attraction F_l at the extremity of a normal bundle, is exactly proportional to its length; this is expressed by the formula $F_l = k^2 l$. If l varies, $k^2 l$ represents a line making with the axis x an angle of which the tangent is k^2 , k^2 doubtless varying with the thickness of the plates, but remaining constant when the thickness is invariable.

V. We have found that for a plate of the given length, $2l$, F varies with the distance to the centre according to the law $F = Ax^2$. If $x = l$, we have $F_l = Al^2$, whence we infer $F_l = Al^2 = k^2 l$; $A = \frac{k^2}{l}$; and the general equation becomes $F = \frac{k^2}{l} x^2$. En résumé, the law

* The original paper gives values for $2l = 310$, $2l = 250$, $2l = 200$, and $2l = 100$.—ED. T. J. & E. R.

of the forces of attraction is expressed by means of a single coefficient, k , which depends upon the thickness of the elementary plate and upon the steel employed, k^2 being a mean equal to 0.240: we have calculated from the preceding formula the values of F corresponding to the several plates, and we find a sufficient concordance between the observed numbers and the calculated.

VI. We admit, with Coulomb, that the force of attraction, F , is proportional to the square of the magnetic intensity at every point, and we can put $F = I^2$; then—

$$I = \frac{k}{\sqrt{l}} x, \quad I_l = k \sqrt{l}.$$

The former equation may be written $I_l^2 = k^2 l$ to show that the magnetic intensity at the extremity of a normal bundle varies as the ordinates of a parabola; and from the latter equation we infer that on the several points of a bar of the length $2l$, this intensity is illustrated by a line making with the axis x an angle

of which the tangent is $\frac{k}{\sqrt{l}}$. Also the normal bundle

possesses the remarkable property that the curve of the magnetic intensities reduces itself to a line. This was known to Coulomb in the case of magnets of 2 lines in diameter and 5 or 6 inches in length.

VII. The total magnetism, M , is—

$$l \times k \sqrt{l} = kl\frac{1}{2}.$$

If the width of the plates is a , their thickness e , and if we neglect the augmentations of intensity which are produced at the corners and angles of the bundle, we must multiply this quantity by the perimeter $2(a + ne)$, n being the number of plates; we have then—

$$M = 2(a + ne)kl\frac{1}{2}.$$

VIII. When we place a contact under the magnet all the free magnetism disappears if this contact be sufficiently large and contain a sufficient quantity of iron. The magnetism, M , is then entirely concentrated on the surface of adherence, which I term S . Its intensity on this surface—that is, the quantity of magnetism per unit of surface—is $\frac{M}{S}$, and the carrying

force $\frac{M^2}{S^2}$; it will be $\frac{M^2}{S^2} S$ for the total surface, or $\frac{M^2}{S}$.

It results from this that the carrying force is in inverse ratio to the contact-surface. This is true if all the free magnetism disappears; it is not true if S is diminished beyond certain proportions. It is for this reason that we generally employ cylindrical contacts and not plane. In replacing M by its value, the bearing force P is—

$$P = \frac{4(a + ne)^2 k^2 l^3}{S}.$$

IX. The weight of the magnet is equal to that of one plate, $2ael$, multiplied by their number, which is proportional to their length, and which we can express by ml : it is then $\pi = 2mael^2 d$. Consequently the ratio $\frac{P}{\pi}$ becomes—

$$\frac{2(a + ne)^2 k^2 l}{Smaed}$$

which measures the bearing force of the magnet in terms of its own weight. This relation will be proportional to the length, to the width of the plate, and in inverse ratio to the surface of contact.

X. There are two I have not examined—the question of armatures, and that of the thickness of the plates. As to the latter point, I have discovered—that the force of a plate increases sensibly with its thickness, but this increase is less than that of the thickness, and quickly attains a limit; but a plate of thickness = 1 is less powerful than two others of thickness = $\frac{1}{2}$, much

less powerful than three plates of the same total thickness in layers. That generally the difference increases with the number of layers of which a fasciculum or bundle of a given thickness is composed. I have been led to the use of ribands of steel; and as these are produced in commerce in abundance and with regularity, of an excellent metal, we have only to superpose a sufficient number to construct a normal magnet and attain the limit of power, while we at the same time greatly diminish the weight. In this manner I have obtained magnets carrying twenty times their own weight.

No. 14.

Memoir on Electro-Capillary Batteries and Actions.—By M. Becquerel.—The principle of electro-capillary actions consists in the property of the humid surface of capillary spaces to conduct electricity similarly to solid conductors, whence result currents which produce in these spaces metallic reductions and other chemical actions. I have described an electro-capillary couple in a preceding memoir (see TELEGRAPHIC JOURNAL, pp. 102 and 108). I have found lately that great inconvenience resulted from the filling of the crack with a deposit of copper. To avoid this inconvenience I have made the following arrangement:—A tube, 1 to 2 decim. in length and 2 c.m. diameter, is cut into rings 2 c.m. in height. These sections are ground with emery until they fit as perfectly as possible upon one another. Between the joints are placed thin plates of beaten platinum, and these are put in communication with the plate of copper of the plugged tube. The rings are tied together by means of two small plates of copper, traversed by three ties of the same metal. The electro-capillary pile is not intended to produce great chemical or calorific effects. Its electromotive force is three-fourths that of a sulphate of copper element, but the resistance is high. In the second part of the memoir I explain the electro-capillary actions produced when a metallic precipitate, or not, moistened with distilled water or a solution, is in contact with a plate of metal, more or less oxidisable, placed between two plates of glass, joined with mastic at the edges, to exclude, as far as possible, entrance of air, and to prevent evaporation of the water. Here we can establish the principle, that the metal oxidised at the expense of the water, which is decomposed, sets free negative electricity; the liquid, positive electricity. Now, each particle of the deposit being surrounded by a layer of liquid infinitely small, acts as does a solid conductor; it produces an electro-chemical effect, resembling that which we observe when a plate of zinc immersed in water is put in contact with a plate of copper. As a peroration to his memoir, M. Becquerel continues—In the present state of our physico-chemical knowledge, it is no more possible to ascribe to the affinities a calorific origin than it is an electrical origin, and reciprocally. Time only will clear up the mystery.

Action of the Electric Flux on Atmospheric Air.—Note by M. Boillot.—In the experiments which to-day I have the honour to submit to the Academy I have sought to realise the most favourable conditions to the production of the electric fluid, in the case of a feeble induction current. Preserving the arrangement of the apparatus I have described in a former paper (see TELEGRAPHIC JOURNAL, p. 117), I have adopted the following dimensions for my tubes:—Length of current, 34 c.m.; diameter of largest tube, 9 m.m.; of the middle tube, 6 m.m.; of the smallest tube, 3 m.m. The carbon is retort graphite, powdered sufficiently fine. A first series of tests had been made on a current of dry air, and subsequently upon a current of dry oxygen. With the current of air I have obtained a mean of 20 to 21 m.gr. of ozone per 5 litres of air, which corresponds approximately to 1 litre of oxygen.

The current of oxygen has given me, under the same conditions, 7 m.gr. of ozone per litre of gas. But I supposed that ozone was not the sole product, but that nitrogen would influence the result. I have therefore re-determined the experiments, and have neutralised the effects of the hypothetical combinations of nitrogen by employing a solution of caustic potash. The result, for air, was identical with the preceding. A further conclusion may be drawn, that oxygen, under certain conditions, is much more easily transformed into ozone whilst it is acted upon in the air than whilst we act upon it in a state of purity, and the difference of the action in the two cases is nearly in the proportion of 3 to 1. Another consequence appears necessary to me; it is, that ozone cannot be considered a combination of oxygen with itself. The union of several atoms of oxygen to form ozone appears to me to be an insupportable hypothesis.

On Composite Electric Sparks.—Note by M. A. Cazin.—I term composite sparks those sparks with several branches which we frequently perceive with the Ruhmkorff coil, especially when the poles of the coil communicate with the armatures of a condenser, or, as took place in the recent experiments made by M. Guillemin, with large metallic surfaces separated from one another. I have discovered that the sparks which compose the bundle are successive, and I have seen their number attain several hundreds by the simple approximation of the electrodes. Here is the principle of my experimental method:—The spark burst in the focus of a collimator on the edge of a disc revolving around its centre. This disc is opaque, and divided into equal parts by lines. From the other side of the disc, and in the passage of the luminous rays of the spark, is fixed a pierced screen, the opening of which is equal in width to a division of the revolving disc. This opening is watched with the glass of a cathetometer, and when a single spark bursts in the focus of the collimator there appears in the field of the glass only a single line of the revolving disc; but when the spark is composite the line is perceived to move in into the various positions which it occupies at the time of discharge of the simple sparks which go to compose the total discharge. I will describe one of my experiments:—The electrodes consist of two platinum buttons of 7 m.m. diameter, their distance being measured by the aid of a micrometer. The disc is 22 c.m. in diameter, and bears 48 divisions. It is rotated by a Froment's electro-magnetic engine, and makes 38·78 turns per minute, the length of passage of a line being 0·0322 second. The poles of the induction coil are put into communication with the buttons of the discharger, and with the extreme armatures of a cascade of three jars. The circuit is opened and closed by hand. Here is a series of observations made at the opening of the circuit:—

Distance of Electrodes. m.m.	Observed Effect.	Duration of total Discharge. Second.
7·00	No spark	—
6·00	A brilliant flash	—
5·00	Do.	—
4·00	2 flashes	0·002
3·00	3 flashes	0·003
2·00	5 to 6 flashes	0·008
1·46	10 flashes	0·011
0·62	Numerous flashes	0·016
0·21	Still more numerous	0·024

An analogous experiment with another disc led me to observe 500 sparks, but in the last two experiments given above the sparks were too numerous to count. We may conclude, from these experiments, that whilst the distance of the electrodes decreases, the number of successive sparks which compose a discharge increases gradually to several hundreds. These experiments are

analogous to those which M. Nyland made upon the mechanical effect of the discharge of an induction coil whilst it traverses a moving strip of paper. He counted a great number of successive holes, which appear to me to correspond to the successive sparks constituting a composite spark.* There is, however, a considerable difference. M. Nyland obtained a considerable number of holes with the direct spark from the bobbin, without the Leyden jar. With me, in this case, the sparks are always simple. I purpose continuing this subject, which may furnish something interesting to the theory of electricity.

Poggendorff's Annalen der Physik und Chemie, No. 1, 1873.

On an Effect of the Induction Spark.—By Dr. Hermann Herwig.—Dr. Herwig has endeavoured to determine the variation, under different conditions, such as at given pressures in certain gases, of the effect of the induction spark. The experiments were made chiefly with an explosive mixture of gas and ordinary air in calibrated glass tubes containing mercury, and a Ruhmkorff's coil giving a 40 c.m. (10 in.) spark in air. From the experiments it was deduced that an explosive mixture is most easily exploded when (1) the pressure is increased, (2) its concentration increased, (3) or a current of some quantity is employed.

A New Variation-Instrument for Measuring the Vertical Intensity of the Earth's Magnetism.—By H. Wild.—A mathematical illustration of a vertical magnetometer.

On the Proportion of the Ohm to Siemens's Mercury Unit.—By Hermann Siemens, Telegraph Engineer, Berlin.—Three original copies of the ohm were employed, No. 21, No. 51, No. 61. The necessary corrections for temperature were made by a good normal thermometer. The electro-motor was two Daniell's elements. The average value of the ohm in mercury units was found to be 1·0493.

The Electromotive Force of Thin Strata of Gas on Metal Plates.—By F. Kohlrausch.—See p. 151.

No. 2.

Differential Thermometers.—By Louis Schwendler.—A translation from the English.

Correspondence.

DIRECT-ACTION BELLS AND BELL CODES.

To the Editor of the Telegraphic Journal.

SIR,—At page 139, column 1, lines 13 and 14, in your report of Captain Mallock's paper on the "Block System," read before the Society of Telegraph Engineers, at their meeting on the 23rd ult., there are two clerical errors. Your words are "the working of bells alone, introduced by Walker on the South Western Railway in 1861." It should be "South Eastern Railway in 1851."

As this is a matter of history, and as bell codes are a most essential feature in all practicable systems of train signalling, it is of great moment that no error of date should stand uncorrected.

On this railway, of about 340 miles, the "Block System" is worked at the present time by 339 electro-magnetic semaphores, of which 281 have direct action bells incorporated with the semaphores, and by 58 with bells detached, but in the same circuit; and by 284 direct action bells, of which many are hearing

* "Journal de Physique," April, 1872. "Archives Neerlandaises," vol. v.

bells only, and the others, which constitute the bell-system proper, are being exchanged for bell semaphores as fast as the instruments can be made and erected. With and without semaphores 623 such bells are now in use.—I am, &c.

CHARLES O. WALKER,
Telegraph Engineer.

South Eastern Railway Electric Telegraph.
Tonbridge, May 19th, 1873.

[Our correspondent's letter includes a table (which we are compelled by want of space to omit), taken from the Half-Yearly Reports of the Telegraph Department of the South Eastern Railway, showing when direct action bells and when electro-magnetic bell semaphores were first employed, and their progressive increase in numbers.—Ed.]

DUPLIX TELEGRAPHY.

To the Editor of the Telegraphic Journal.

SIR,—I note in your journal of 15th February, in your article on "Duplex Telegraphy," that Mr. Baggs was the first to add the condenser to the existing apparatus. I had supposed myself familiar with all that had been made public in Europe or this country in double transmission, but the fact, or the mode of the application of a condenser by Mr. Baggs is new to me. Will you be so kind as to note in your correspondent's column in what book I can find an explanation thereof?

The Stearns duplex has been used for several years in the United States. The longest circuit worked at present is New York and Chicago, 1000 miles. This is really worked in two circuits, with an automatic repeater at Buffalo, half way. Operators prefer working it to a single wire system, getting off much more business in a day. Two weeks ago, between Buffalo and New York, over 1600 messages (averaging 25 words each) were handled between 8 a.m. and 6 p.m.

Until its application to very long circuits, with large conducting wire, No. 6, a condenser was unnecessary. But when tried between Chicago and Buffalo, it was found that when the sending key opened, changing from battery contact to ground, and closing one before breaking the other, a portion of the charge in the wire, reversing its direction, flowed back, discharging through the sending relay, and making a false dot, or, as the operators term it, a "kick." A condenser of the same capacity as one half the line wire, was then put upon the rheostat circuit, and upon moving key from battery to ground, the discharge from the line through one coil was balanced by the discharge from the condenser through the other. This entirely removed the "kick."

Stearns's system is at work on many circuits of 150 to 400 miles, and is doing splendid work. Mr. Stearns is now in England, with Mr. Prescott and General Eckert. He has a set of his apparatus with him, and will, I doubt not, exhibit its capabilities to all. Like all double transmission systems since Gintl, it follows the general path, varying only in a few essentials, which, though trifling in appearance, have made what was before an experiment and a toy a valuable adjunct to telegraphy.

Mr. Prescott and General Eckert will bear testimony to the efficiency of Stearns's system, as will all telegraph officials in this country.—I am, &c.

C. H. HASKINS,
Genl. Supt., Milwaukee, U.S.A.

North Western Telegraph Company,
Milwaukee, Wis., April 11, 1873.

[A description of Mr. Baggs's condensing system is to be found in his letters patent.—Ed.]

City and Commercial Notes.

THE Telegraph Construction and Maintenance Company have successfully repaired the French Atlantic Telegraph Company's Brest St. Pierre Cable, which was interrupted on the 20th April.

The Anglo-American Telegraph Company announce that, in consequence of the repair of the Brest St. Pierre Cable, on the 20th ult., the tariffs for messages between the United Kingdom and New York, and all places easterly thereof, is reduced from six shillings to four shillings per word. The tariff upon messages from the Continent of Europe, and all other places not having adopted the word-system of charging between the same places, and between Brest, France, and New York, and all places easterly thereof, will be at the rate of two pounds sterling for a message of ten words, and four shillings per word for additional words beyond ten.

At the special meeting, on the 22nd ult., of the Anglo-American Telegraph Company, Limited, the terms of the amalgamation (which have already been published in our columns) with the French Atlantic Company and the Newfoundland Company, were confirmed, after an expression of opinion on the part of some of the shareholders that the terms were not sufficiently favourable to this Company.

At a meeting of the French Atlantic Telegraph Company, held on the 23rd ult., the resolutions for the voluntary winding-up of the concern and the transfer of its business to the Anglo-American Company were adopted, and the following gentlemen appointed liquidators:—Lord Monck, Lord William Hay, Baron Julius de Reuter, Mr. Edward J. Halsey, and Mr. Eaton T. Cummins.

The accounts presented, on the 21st ult., at the meeting of Reuter's Telegram Company, Limited, showed that the net profits earned during the year ending the 31st December last, after payment of all current charges, and making full allowance for all bad and doubtful debts, and for rebate on unexpired subscriptions, amounted to £7686 7s. 5d., including £964 9s. 8d. brought forward from last account. An interim dividend at the rate of 2½ per cent having been paid in October, the directors now declared a final dividend at the rate of 7½ per cent, free of income-tax, making a distribution of 10 per cent for the year. A balance of £291 19s. 5d. is carried forward to next account.

The following telegram was received by the India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited, on the 22nd ult., from Capt. Hunter, R.N., steamship *Dacia*, Havannah, :—"We have completed the laying of the new cable between Cuba and America." This, with the old cable repaired ten days since by the *Dacia*, makes two cables now at work between Cuba and Key West.

At the meeting, on the 20th ult., of the British Australian Telegraph Company, Limited, the resolutions passed on the 5th inst. were confirmed.

At the meeting on Friday, the 23rd ult., of the Great Western Telegraph Company, Limited, the special resolutions passed at the extraordinary general meeting on the 8th inst., for the voluntary winding up of the Company and for the sale of its business and property, including the cables made under the contracts with Hooper's Telegraph Works, Limited, in exchange for the same number of shares in the capital of the Western and Brazilian Telegraph Company, Limited, were confirmed.

Reuter's Telegram Company, Limited, announce that, in consequence of the cable between Madras and Penang having been repaired, messages can again be sent, *via* Falmouth, to the Straits, China, Japan, and Australia, at former rates.

The Eastern Telegraph Company have received the following telegram, on the 24th ult., from the steamship *Ayres*, engaged on the repair of the section of cable between Madras and Penang:—"S.S. *Ayres*, 6 a.m., Saturday. Now going to splice and pay out to Penang. Buoyed on Tuesday. Latitude, 7°44'; longitude, 93°27'. About to make final splice." A later telegram, dated Saturday, 12.45, states:—"Ayres reports Penang end parted when about to splice up; strong current; keeping constant watch here."

The Indo-European Telegraph Company, Limited, announce that the cable between Madras and Penang, which was interrupted on Sunday, May 11th, having been restored, messages may be again telegraphed direct to Penang, Singapore, China, Japan, Java, and Australia, by the lines of this Company, *via* Teheran. The regular tariff for these places will be resumed, in lieu of the temporarily reduced tariff charged during the interruption.

The feature in the Telegraph Market on Tuesday, the 27th ult., was the fall in the Atlantic lines, which was attributed to the telegram from "a correspondent" of the *Times*, stating that "the Newfoundland Government have notified the New York, Newfoundland, and London Telegraph Company that the right of pre-emption will be exercised by the Newfoundland Government in April, unless the monopoly of landing cables is surrendered by the Company."

TELEGRAPH SHARE LIST.

Amount per Share.	NAME OF COMPANY.	Amount paid up.	Closing Quotations.
£		£	May 29.
Stock	Anglo-American (Limited)	100	137-139
10	Brazilian Submarine	3	14-1 dis.
10	Cuba	All	94-98
10	Eastern Telegraph Co.	All	94-98
10	Ditto Extension	All	94-98
10	Great Northern	All	104-11
20	Great Western	13	5-4 dis
25	Indo-European	All	16-18
10	Mediterranean Extension (Limited) ..	All	53-6
20	New York, Newfoundland, and London ..	20	21-21½
8	Reuter's	All	104-11
20	Société Transatlantique Française ..	All	324-32½
Stock	Submarine	100	230-240
Cert.	Ditto Cables Trust	100	110-115
10	West India and Panama	All	64-7
10	Hooper's Telegraph Works	All	123-13
50	India-Rubber and Gutta Percha	All	34-35
*12	Telegraph Construction	All	324-334
Cert.	Ditto Ditto 3 years' Bonds ..	100	103-105
20	Direct United States Cable	5	1 dis-par
1000 dls.	West Un. U.S. 7 per cent 1st M.B. ..	All	91-93

* Capital reduced by £8 per share out of profits.

THE ORIENTAL TELEGRAM COMPANY.—The method of "coding" messages seems so little understood that some slight explanation may not be out of place. There are certain phrases which it has been found occur sufficiently often in telegraphic communication to become capable of being stereotyped in one set form: thus "Stocks have gone up" or "gone down," or "Come at once," are phrases which may be represented by one word, or even a symbol, agreed upon between sender and receiver. In this manner a message may be considerably shortened, and the expense of transmission reduced. The Oriental Telegram Company has, we believe, been started with the view to "code" messages in a similar manner for those of the public who may care to become its subscribers. The idea, though limited to certain applications, is a striking sign of the tendency of the present age to economise. If by such means the cost of general messages can be reduced so as to place our cables within the reach of all, not only will the cables derive benefit from the increased work, and security in the constant supply of that work from more numerous sources, but an important social step will have been taken.

Patents.

2923. C. H. Siemens, London. *Electrical apparatus.* A communication. Dated October 3, 1872. This invention relates to improvements in the construction and working of alphabetical dial telegraph instruments, whereby messages are transmitted, received, and printed by means of electricity, and also of electrical signalling instruments and apparatus to be used chiefly on railways for the purpose of guiding and controlling traffic, and the working of points, signals, and similar apparatus. The improvements in alphabetical dial telegraph instruments relate chiefly to the arrangement of one dial which serves to indicate both for transmitting and receiving messages, to means of latching the finger keys, whereby any key is held down till released by the depression of another key, and to a peculiar construction of spring pawl for engaging and disengaging the commutating apparatus. The further improvements in such instruments when used for printing relate to a construction whereby the mere cessation of the currents brings the printing mechanism into action, without the necessity for a separate current for that purpose. For signalling on railways, indices, biased to move in one direction, are employed. These are permitted to move by the action of an escapement of a number of successive alternately positive and negative currents transmitted from one signalling station to another. Thus one accidental current makes no appreciable difference to the signal. Such signalling instruments are interlocked with each other and with the ordinary point and signal apparatus, in such a manner that the traffic can be controlled from one station to another or from a central station. Similar appliances may be used in connection with gates, turntables, or swing bridges on railways, and also on canals and other lines of traffic.

2945. M. Doubelt, St. Petersburg. *Transmission of telegraphic despatches.* A communication. Dated October 5, 1872. This consists chiefly in a cylinder in electric connection with a keyboard, by which it is governed.

2987. M. Henry, London. *Apparatus for sustaining and insulating telegraph wires.* A communication. Dated October 10, 1872. Insulators are so arranged as to cause the electric current to overcome two insulators before reaching the cross bar or pole and two or more insulators before it can reach and form a weather cross with another wire upon the cross bar. A series of insulators and dry surfaces are provided between points liable to be brought into communication by moisture. An arrangement is described in which an insulated cross bar carries an insulating column having annular depressions, also a second similar column and a suspended insulator for sustaining the line wire, and having also an annular depression.

2996. J. R. S. Hayward, Shirehampton, Gloucestershire. *Application of electricity to the cure of certain bodily ailments.* Dated October 10, 1872. This invention relates to an improved construction of galvanic belt for the application of galvanic electricity in the treatment of nervous disorders.

3299. W. R. Lake, London. *Improvements in electric torches for lighting gas.* A communication from W. W. Batchelder, of New York. Dated November 7, 1872. This invention relates to hand devices or torches for lighting gas by the generation of an electric current, and consists in an electric torch, complete in itself, both in the generation and liberation of the electric spark; that is to say, a device that is independent of the gas burner or fixtures to which the gas burner may be attached, or any medium independent of the torch itself except the hand. And the invention further consists in a torch constructed with a chamber or deflector for receiving the escaping gas and mixing it

with the air, so as to light the gas with the deflector away from the burner.

3329. G. G. Newman, of Lancaster, and E. G. Bartholomew, of Middlesex. *Improved means and apparatus for signalling between carriages of railway trains, and appliances for connecting the wires of adjoining carriages or vehicles.* Dated November 9, 1872. Within each compartment of a carriage is fixed a handle, by the motion of which an indicator fixed externally on the carriage is released, by which the guard or other official is made aware of the point whence the signal originated, at the same time effecting a contact between wires which run from end to end of each carriage throughout the train, and by such contact causing alarms to sound in the vans or engines, or both, in order to attract attention. This invention further consists of a peculiar arrangement of hook or fastening, placed in convenient positions upon the carriages, vans, and engine, whereby, in the event of a coupling becoming broken and any portion of a train becoming unintentionally separated, the alarms are immediately brought into action.

3344. J. B. Stearns, Boston, U.S.A. *Improvements in electric telegraphs.* Dated November 11, 1872. These improvements have been detailed at page 118 of this journal.

3360. E. P. H. Vaughan, F.C.S., Middlesex. *Improvements in the mariner's compass.* A communication from L. and D. Ripamonti, of Paris. Dated November 12, 1872. The object of this invention is to provide a simple and efficient means of adjusting the mariner's compass. To this end the influence of a number of magnetised steel bars is brought to bear on the axis of the compass needle, they being so arranged that their centres coincide with the vertical prolongation of said axis.

3368. C. A. Randall, of New York, U.S.A., and of Middlesex. *Improvements in printing telegraphic apparatus, and in the arrangement of the circuits to be used in connection therewith.* Dated November 12, 1872. The improvements in the recording instrument consist, 1st, in the mechanism for shifting a single type wheel, provided with two sets of characters so that it may be changed by the sending operator, and made to print either set of characters at will. 2ndly. In the combination of said mechanism with the printing lever for effecting directly, by the action of the printing magnet, the said change of the wheel. 3rdly. In the mechanism to rotate the type wheel, whose shaft carries two ratchet wheels, actuated by alternately pawls jointed to a rock lever connected to the armature of the type wheel magnets. 4thly. In the combination with a type wheel, capable of being so changed, of an automatic unison. The improvements in the transmitter consist in so arranging the lettered keys of an automatic current transmitter, that the said keys, and the printing key (when a special current to print is employed) may be manipulated with one hand, the said keys being arranged in a circle with the printing key in the centre. The batteries and circuits are so arranged that a current passing over a circuit may pass through a helix or helices, and polarise one or more soft iron armatures, and by sending a current from another battery over the same wire, the printing magnets are changed, and the printing from the type wheel effected. In combination with the electrically polarised armature are electro-magnets in a circuit, over which reversed currents are caused to pass for effecting the rotation of the type wheel. By another arrangement of circuits and batteries, a non-polarised armature is employed, and currents are caused to pass alternately through the type wheel magnets and one helix of the printing magnets for rotating the type wheel, the printing being effected by a current passing simultaneously over both circuits, using both wires as a metallic circuit or with earths.

NOTES ON THE ATLANTIC CABLE EXPEDITION.—The Robert Lowe will lay the shore-end from Valentia, and 80 miles of "intermediate" cable, the latter in 1200 fathoms water. Splice will then be made with *Great Eastern* tanks. The cable will thence be laid from the fore tank at a uniform speed of 5 knots an hour. Next the cable in the aftermost tank will be paid out; the third tank will then be emptied, and, finally, the main tank. The course to be taken is 35 miles N. of the working cable, which is about the same distance N. of the broken one. The *Hibernia* will assist in sweeping for and buoying the broken cable.

The estimates for the Post-Office Telegraphs recently issued exhibit the great dimensions of the new Department which Mr. Scudamore has built up. In the 97 district and branch offices in the London district the Department makes provision for 195 male and 292 female clerks, as well as for 847 messengers. The cost incurred during the year will be £60,670, which is at the rate of £45 gs. 7d. per head. Allowing for the estimated rate of increase, the messages forwarded from those offices during the year ending 31st March, 1874, will produce a revenue of £144,560 against the estimated cost of 60,670. The cost of each operation on the wire will be about 2½d. In the schedules relating to the country provision is made for the cost of 341 head offices, 80 branches, and 77 railway stations (in Ireland); for the salaries or wages of 3518 officers and clerks, and 2110 messengers (5628 in all), all the allowances for rents or incidental expenses, &c. The establishment for the United Kingdom, under the foregoing schedules, will consist, for the year to 31st March, 1874, of 5628 persons, and will cost for that year £306,528, or about £54 gs. 4d. per head. The messages which will be forwarded from the offices during the year, due allowance being made for the usual increase, will produce £554,910. Reckoning the transmitted messages as involving two operations per message on the wire, the offices named in the foregoing schedules will have 49,077,132 operations on the wire during the year for private messages alone, and the cost will be about 1½d. per operation.—*Echo*.

MAGNETIC EFFECT OF LIGHTNING.—A sewing-machine company recently received a needle from a machine that stood in a house struck by lightning, which was so highly magnetised that it would lift a shingle nail, or any other piece of iron or steel of equal size. The machine itself, which had been pronounced an excellent and easy running one previous to this occurrence, would never do service afterward, the friction of the machinery becoming so intense as to exhaust the operator in a few minutes. This condition was all the more mysterious from the fact that the structure of the machine had not been damaged or disturbed in the least.—*The Telegrapher*, April 19, 1873.

POST-OFFICE TELEGRAPHS.—The undermentioned postal telegraph offices have been opened for the transaction of telegraphic business since the publication of the last list of postal telegraph offices:—England: Ballaugh, near Ramsey, I.M.; Coalbrookdale, near Wellington, Salop; Gamlingay, near Sandy; and Woodlesford, near Leeds. Scotland: Edinburgh, Crown Street, Leith Walk. The undermentioned railway stations have been opened for the transaction of telegraphic business on behalf of the Postmaster-General:—England: Radford Station, Midland Railway; and Wheathampstead Station, Great Northern Rly. Scotland: Luncarty Station, Caledonian Rly.

To Correspondents.

The description of Mance's method will be given in our next; it is unavoidably crowded out.

F. W. O.—Your letter in our next number.

HORNBURG AND VIENNA RUBBER-WORKS.—M. Mayer, whose name we gave, is the inventor. But we don't quite understand. Our authority is the official "Journal Telegraphique."